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THREE YEARS' RESULTS WITH THE USE OF COPPER, MANGANESE AND ZINC SULPHATE IN FERTILIZER MIXTURES FOR POTATOES

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It is recognized (6) that copper, manganese and zinc are elements that are necessary for the proper functioning of green plants. Further it has been shown (1,2,3,5,7,8,9) that the application of salts of these elements under certain conditions has increased crop yield. For this reason it was of interest to know whether or not these elements would increase the yield of potatoes on the average potato soils in eastern Virginia.

The sulphate salt of each of the elements was used at the rate of 50 pounds to the acre and 75 pounds of a mixture of all three materials were used on plats varying from two rows 100 feet long to six rows 50 feet long. This quantity of the compounds was used because Russell et al. (3.7) have reported large increases in crop yield with this amount. The general method was followed of applying the fertilizer down the row, sprinkling the respective elements down on top of the fertilizer, mixing both with the soil with a spike toothed harrow and planting the potatoes about one week later. In one or two cases, however, the compounds were added after the plants had germinated. In these cases the compounds were applied on the inside of the rows and worked in the soil with the normal plowing of the crop. From the way the materials were added there was little probability of adjacent rows obtaining any of the respective elements. The plats were laid out according to Fisher's method (4) and the results were analyzed statistically. The results are reported in table 1 in bushels to the acre. The data given are an average of five plats. It will be noted that the variation in yield for the respective plats was rather small. In the few cases where the variation was rather wide the differences are not significant. On farm L a rather large increase was

TABLE 1.—*The influence of copper, manganese, and zinc sulfate* (c) *upon the yield of potatoes*

Treatment	Yield in Bushels per Acre													
	1934							1935					1936	
	Farm A	(b) B	(b) C	(b) D	(b) E	(b) F	G	H	I	J	K	L	M	N
Check (a)	211	333	308	306	411	329	201	182	190	200	174	258	119	134
Cu	194	315	294	270	378	314	197	147	208	184	164	297	125	141
Mn	189	346	305	296	405	331	189	167	193	202	186	286	123	140
Zn	206	341	303	294	391	323	197	151	206	190	154	293	113	150
All	185	330	276	274	385	318	174	156	211	194	152	326	131	

(a) 1 ton 6-6-5 fertilizer per acre on all plats.

(b) Total yield—others, yield of primes only.

(c) 50 pounds per acre of each. Mixture—25 pounds per acre of each.

obtained but because of soil variability the increase failed to be significant. In fact, not a single case showed a significant variation either in an increase or a decrease from the check plat.

Conclusions

From a study of fourteen experiments with copper, manganese, and zinc no significant increase in yield was produced. From these experiments it is concluded that it would be inadvisable to add these elements to the fertilizer mixture for potatoes in this section at this time.

LITERATURE CITED

1. Allison, R. V. et al. 1927. The stimulation of plant response on the raw peat soils of the Florida everglades through the use of copper sulfate and other chemicals. Fla. Agr. Exp. Sta. Bul. 190.
2. Barnette, R. M., et al. 1936. The use of zinc sulfate under corn and other field crops. Fla. Agr. Exp. Sta. Bul. 292.
3. Churchman, W. L., et al. 1936. Copper sulfate as a plant nutrient and soil amendment. Crop Protection Digest. Bul. Series 55.
4. Fisher, R. A., and Wishart, J. 1930. The arrangement of field experiments and the statistical reduction of the results. Imp. Bureau of Soil Sci. Tech. Communication 10.
5. Gilbert B. E. 1934. Normal crops and the supply of available soil manganese. R. Is. Agr. Exp. Sta. Bul. 246.
6. Miller, E. C. 1931. Plant Physiology. McGraw-Hill Co., N. Y.
7. Russell, R., and Manns, T. F. 1933. The value of copper sulfate as a plant nutrient. Trans. Penin. Hort. Soc. 23:51-57.
8. Skinner, J. J., and Ruprecht, R. W. 1930. Fertilizer experiments with truck crops. Fla. Agr. Exp. Sta. Bul. 218.
9. Townsend, G. R., and Wedgeworth, H. H. 1936. A manganese deficiency affecting beans. Fla. Agr. Exp. Sta. Bul. 30.

THE VALUE OF SEED POTATO CERTIFICATION TO THE POTATO INDUSTRY[1]

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There is no longer any doubt about seed potato certification being of definite value to the potato industry. It has been on trial for twenty years, has proved its worth, and has been accepted unconditionally by the potato industry throughout the North American continent. It has extended in recent years to the Antipodes and to parts

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of Europe, and it will probably be started in parts of South America this year.

The principal object of this paper is to present a brief summary of general interest on some good results obtained from seed certification, drawn from miscellaneous but reliable data, and to show that seed certification must be continued on a permanent basis, and also that it has by no means reached the full limits of its usefulness to the potato industry.

It is not considered essential to give more than a brief synopsis here of some of the data available, to illustrate the chief points on which the conclusions to be arrived at are based, for the members of the potato Association of America are generally well informed in this respect, and have most of these data readily available.

Comprehensive information on comparative yields from certified and non-certified seed was given by Moore (1) in 1924. He mentioned that 115 Experiment Stations and Extension workers in the United States and Canada were asked for results secured in their states or provinces. The data given represent results from 11,627 tests conducted in twenty-seven states and eight provinces. A summary of all reports secured indicated that on the average certified seed will outyield non-certified seed by approximately forty-six bushels to the acre, and that the crop produced from certified seed is of much better market quality than that produced from non-certified seed.

A study of the voluminous data published subsequent to Moore's investigations would indicate an even wider margin in favor of certified seed, and at the present time it seems fairly well agreed that the yield secured from fields passing inspection for certification purposes would average nearly double those shown in statistical reports issued for the same districts. This certainly is the case in Canada, and the seed yields are based upon reliable inspectors' reports made at bin inspections, which may be accepted as reasonably correct.

The quality of seed planted is one of the most important factors in the production of profitable crops. Good seed means tubers that are free from disease, free from variety mixtures, from a high yielding strain, grown under favorable climatic conditions, and firm and sound at planting time. All qualifying yields in the 300, 400, 500 and 600 bushel clubs are grown from certified seed or seed not over one or two years removed from certification. The only possible method of being sure that seed is good is to obtain certified seed.

Production costs are found to coincide closely with yield,—that is the higher the yield the lower the cost for each bushel. Convincing

evidence of the value of certified seed is seen in the fact of the growing demand for it year by year, and at a substantial premium over table potatoes. The following table indicates the steady growth of the seed potato industry on the North American continent in the past sixteen years, and demonstrates most conclusively that it pays to plant certified seed.

CERTIFIED SEED POTATOES, UNITED STATES AND CANADA

Year	Acreage Certified	Total Production
		(Bushels)
1920	10,674	1,294,671
1925	36,279	5,745,029
1930	68,057	11,171,411
1935	83,537	16,551,608

The opinion was expressed in 1925 in many quarters that certified seed production had almost reached the full limit of demand for that class of seed. Certified seed production in 1935, however, was about two hundred per cent higher than in 1925, and even that quantity was barely sufficient to meet the requirements of the trade. One logical reason offered is that most growers are asking for it and the majority of seed dealers are now convinced that certified seed is improved seed. The dealers like to have a constant and dependable supply of well-graded healthy vigorous seed potatoes for their trade. They know that certified seed has been selected, grown and rogued for diseases under supervision, and is inspected and passed upon by an unbiased third party of sound integrity who is just as anxious as the dealers are that the seed purchasers are fully satisfied. Furthermore the field reports of the inspectors are available and can be relied upon, which in their opinion is better than having to depend upon the grower's interpretation of the quality of potatoes he may have for sale.

Seed certification was originally established to combat potato virus diseases. These complicated groups of plant maladies had become so firmly established in the potato crop that serious concern was felt by the pathologists, and grave doubt expressed on many occasions as to the possibility of checking the spread to all potatoes. This doubt still exists to some extent and without seed certification it would probably

materialize in a very short period, therefore certification MUST continue for many years to come. Without certification methods applied, even the best of the present day strains of seed potatoes would soon pass into oblivion in the same way as the hundreds of varieties, so popular twenty-five years ago, have done. One good reason why many of those popular varieties are no longer in existence is, that no one carried out disease control work on them. Disease control work had to be centered on a few of the best standard varieties when the work was started and these have been successfully maintained.

A study of the data secured from inspection records appears to indicate that, under present certification rules and procedure, seed potatoes may be maintained for many years in quantity production and comparatively free from diseases, in Canada. The following table indicates the average percentage of Black Leg, Leaf Roll and Mosaic found in all fields entered for inspection from 1922-1936, in five-year periods. Here again the value of seed certification to the potato industry is evident.

Percentage of disease found in fields inspected for certification in Canada, 1922-1936

Period	Total Number of Fields Inspected	Average Percentage of Disease Found		
		Black Leg	Leaf Roll	Mosaic
1922-1926	20,537	.67	.34	2.39
1927-1931	47,855	.22	.13	.76
1932-1936	41,496	.16	.21	.9
Year 1936	7,586	.14	.16	.74

All seed planted was certified the previous season

The reason for the increase in leaf roll and mosaic for the period 1932-'36 was largely due to economic reasons. The premium for seed was lower during part of this period and less roguing was done. When a fair premium is obtainable more careful roguing is done.

Schultz and Folsom (2) had noted an encouraging improvement in the potato virus situation by 1928. Their summary of the situation, presented at the annual meeting of Potato Association of America at that time, was as follows:

"Our present knowledge of potato virus diseases therefore stimulates the production of better seed potatoes. It is reasonable to expect that if the control measures suggested by different workers in this field are rigidly observed, seed potatoes with less disease than in the past will be produced.

"At the same time we must recognize that we need much additional information on insect and host relation; seed plot methods involving isolation, roguing, spraying, etc.; disease resistance; and on similar problems making certain localities more favorable than others for the production of seed potatoes, so that more effective control measures may be recommended later.

"However, information already obtained along these lines has considerably enhanced the production of better seed potatoes within the last decade. In fact the percentage of virus diseases in certain localities has been reduced fully 75 per cent within this period as a result of recent discoveries in the field of potato virus diseases."

Our records of field rejections in Canada would appear to substantiate the above statements, for an average of 32.05 per cent of the total fields were rejected, principally for virus diseases, during the five-year period 1921-1925, and only 24.19 per cent for the five-year period 1931-1935 with a much higher standard in effect, and more than double the acreage.

Substantial progress has more recently been made in improved methods of combating diseases. Some remarkable results have been secured in producing disease-free seed by the tuber-unit plot method, especially where the roguing has been carefully done under the supervision of a pathologist or seed certification officials. Stuart (3) details improvement which he noted on a farm in Aroostook County, Maine, as follows: In 1931, five acres planted on the tuber-unit basis gave a yield of 1,820.5 bushels. In 1932, approximately 47.7 acres were planted in tuber-units with seed from the previous year's five-acre seed plot and the average yield for each acre was 352 bushels. In 1933 about fifty acres were planted, as in the previous season, on the tuber-unit plan and the average yield was nearly 331 bushels to the acre. When considering the yields account must be taken of the fact that a blank space or missing plant occurred between each tuber unit, as well as an additional reduction in yield caused by the entire removal of all diseased or weak units. He concludes by saying that perhaps one of the most encouraging results secured has been the demonstration that to date, at least, it has been possible to continue growing the same seed stock in Aroostook County without any apparent increase

in disease content. Baribeau, (4) dealing with one strain of certified seed, showed that practically no increase in yield was evident in 1926-1927-1928 when no selection other than removal of diseased or malformed tubers was practiced, but planting the same seed stock produced in tuber-units in 1928 and subsequent years, the yields were as follows:

Year	Method of Selection	Yield Obtained per Acre in Commercial Fields
1928	None	287.7 bushels
1929	Tuber unit seed	369.1 "
1930	" " "	382.1 "
1931	" " "	388.0 "
1932	" " "	398.6 "
1933	" " "	389.7 "
1934	" " "	417.0 "

The results show the great value of a tuber unit plot and the benefits that may be expected from it under practical farm conditions. Many similar reports are available but only one more will be mentioned here, that of the improvement in Bliss Triumphs by tuber unit plot work. A few years ago not more than 50 per cent of this variety, which is very susceptible to Mosaic, would pass the standard for certification each year in Canada, but since the practice has been followed of producing the foundation seed stock in tuber units, the percentage of fields entered and which have passed for certification has been as follows: 1933, 82 per cent passed; 1934, 97 per cent passed; 1935, 96 per cent passed, and in 1936, 97.5 per cent passed.

The value to the potato industry in having a trained staff of seed certification inspectors who are keenly appreciative of their problems, is also evident. The inspection services have been termed the "watch dogs of the potato industry," and this is true in many ways. The inspectors must contact at least twice each season, the seed growers who are naturally observant where potato troubles are concerned, and anything out of the ordinary is brought to the attention of the inspector, who can, if such action is deemed necessary, forward particulars immediately to the proper authorities concerned and prompt ac-

tion is possible. The inspector can reciprocate by advising the best growers of any new developments in the field of science with respect to potato growing, and advise where the necessary information may be obtained. The inspectors, too, know the location of all the best fields and strains of seed, and the most reliable potato growers, and can arrange for the multiplication of the best strains and of promising new varieties in the best locations.

Another of the many services offered by some of the certification services is the issuance of seed and health certificates required in connection with export trade. Many importing countries now demand official health certificates guaranteeing that the potatoes have been inspected twice in the field and after harvest, and are entirely satisfactory for seed purposes, before the potatoes are allowed entry as seed.

In conclusion, it would appear that the system of free inspections on certified seed, as applied in Canada, is a fair policy. The object is to make available to the potato industry a plentiful supply of good, vigorous, disease-free seed at a reasonable price rather than spend as much or more in trying to control diseases after they have become seriously established throughout the country. Not only the certified seed growers but the whole potato industry, and through them all consumers, benefit from the services of seed potato certification.

LITERATURE CITED

(1) Moore, H. C. 1924. Evidence that certified seed is improved seed. Proc. Potato Assoc. Amer. 11:26-40.
(2) Schultz, E. S., Folsom, Donald. 1928. Recent potato virus-disease information contributing to the production of better seed potatoes. Proc. Potato Assoc. Amer. 15:203-227.
(3) Stuart, William. 1934. Growing seed potato foundation stock. Amer. Pot. Jour. 11:246-247.
(4) Baribeau, B. 1935. The tuber-unit seed plot in Quebec. Amer. Pot. Jour. 12:62-64.

REPORT OF THE COMMITTEE ON STANDARDIZATION OF FIELD PLOT TECHNIQUE

Judging from the correspondence between members of your committee on standardization of potato field plot technique the report of that committee ought to evoke some discussion. Many of the recommended practices will become bones of contention not alone between the north, south, east, and west, but also between the conservatives and the liberals and the horticulturists and the mathematicians. Even the committee is not entirely in accord on every point. Be that as it may, here is the report.

In establishing standards for potato field trials, the committee had in mind specifically a standarized procedure for the testing of new seedlings. It is probable that much if not all of the technique may be applicable to other forms of potato field trials such as seed source tests, variety trials, seed treatment comparisons, and the like. In view of the fact that fertilizer and spraying trials are accompanied by special problems no attempt has been made in this report to standardize trial technique for that type of experiment. That should be another job in itself.

Seed Stock

The seed stock used in any potato trial should be assembled at one location as soon as practicable after harvest.

Because of the effect of difference in maturity of tubers on the sprout emergence the following year, seed stocks should be assembled from one general area, or all stocks to be tested should be grown one year at the experimental location before placing them in the trial. Deviations from this procedure should be clearly specified when reporting experimental results.

Uniform storage conditions are necessary because of the real effect of storage on the vigor of sprout growth. Because of critical periods such as late spring frosts, time of emergence, midsummer heat, and dry periods, time of sprout emergence may be an important factor in determining final yield.

Keeping seed dormant will discount considerably the variable germination caused by apical dominance. Seed tubers may be green-sprouted if desirable. If seed is cut several days ahead of planting, sprout emergence will be less variable. Cut seed pieces should be allowed to cork over.

In view of the fact that relatively few individual tubers are represented in most potato trials it is desirable to cut as few pieces from one potato as possible, the ideal might be one piece from any one potato.

Location of Seed Plot

The test plot should be located on a reasonably uniform piece of soil with no natural breaks such as dead furrows, back furrows, shrubs, trees, boulders or what not. When such things do occur in the test plot area then a number of guard rows should be planted to discount the effect natural breaks of this nature might have on plant growth.

The test plot should be within a large field of potatoes or surrounded by a wide margin of guard rows not used to furnish data.

Planting

In the single-hill plots and short-row trials planting is best done by hand. When planting single rows an extra guard hill is planted at each end of the row and these two hills are discarded at harvest time. Uniform spacing and plots of equal length are extremely important, particularly in yield trials.

If planting by machinery will accomplish uniform spacing, by all means use machinery.

When planting by hand the seed pieces must be covered immediately with some soil.

In order to dig by machinery no less than four feet in the clear should be left between rows end-to-end.

Sprayer-Wheel Damage

In order to take care of wheel damage adequately there must be planted four guard rows and the sprayer must be driven through those rows at each spraying. This requires a great deal of land, labor, and expense.

Small sprays may be used to advantage in experimental plots.

The damage by sprayer wheels may cut the yield 10 to 15 per cent. The yields of the sprayer-wheel rows might be arbitrarily increased by that amount or the damage might be disregarded but neither adjustment could be justified mathematically.

The spray machinery might be driven through all rows equally often, yet no farmer could be persuaded to do such a thing.

In final-tests of relatively few things multi-row plots including as many rows as the sprayer covers would solve the problem.

Cultural Care

Throughout the season the field trial should receive the best of care so far as weeding, cultivation, spraying, and other cultural practices are concerned.

Harvest

The single hills and small plots have to be dug by hand.

The larger plots may be dug by machine. Considerable skill and judgment must be used in order to dig all rows equally well.

When digging alternate rows particularly in wet soil, adjustment of the digging depth is necessary to compensate for digger wheels being on hard ground the first time through and on loose soil the second time.

If planting has been done properly the digger with an independent drive works easily. The machine should be stopped at the first hill of the next section, the elevator rolled back, and the machine cleared before lifting the next row.

The old traction-drive machine may be used but greater caution is necessary and the job is slowed down materially.

Grading

Less damage and perhaps a better job of grading will result if the grading is done some time after harvest. The several replicates of any one strain may be run over as one lot.

Tests for Disease

Scab and Rhizoctonia. If sufficient stock is available it is preferable to start these tests with tubers from the original seedling. In any event these tests should be started no later than the second year from the seedling. The test plot should be located on a site known to be favorable to scab or Rhizoctonia or the viruses and whatever other condition that may be under consideration.

The first year, plant a whole tuber from the seedling in hills double the usual spacing in the row and a standard or check in every fifth hill; the second year, plant five-hill plots with a check every fifth plot; the third year, plant ten-hill plots with a check every fifth plot; the fourth year, plant twenty-hill plots, every other row a check, replicate to five;* and the fifth year, repeat as in the fourth year, except replicate to ten.

Presumably some of the seedlings may show real differences at the end of the fifth-year test. In order to measure the smaller differences it would be necessary to repeat the "fifth-year" test one or two years more.

Observations of insect resistance could be made throughout the trials.

Virus diseases. The virus diseases constitute a special case in

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*One plot replicated nine times makes ten plots in all. There are ten replicates in such a planting because any one plot is a replicate of any other plot in a repetitious planting. In this report the statement, "Plant twenty-hill plots and replicate to five" indicates that there will be five plots, each of which is twenty hills long.

that the check rows should be planted with tubers carrying as many viruses as possible.

During the following year in addition to the regular field planting to obtain a measure of infection in the seedlings, a single tuber from each hill of every seedling each year should be tuber-indexed to furnish additional information as to resistance or susceptibility.

Tests for Yield

The first year plant a whole tuber from the seedling in hills double the usual planting distance with a check every tenth hill; the second year plant ten-hill plots in duplicate with check every tenth plot, or, plant a single 24-hill plot with check every fifth plot; the third year plant 24-hill plots, replicate to five, check every tenth plot; the fourth year plant 24-hill plots, replicate to ten, check every tenth plot; the fifth year to eighth year repeat same as fourth year.

The technique presupposes rapid elimination in the earlier years, reducing the number entering the final tests to about 15 per cent of the original number.

The size of plot cannot be set arbitrarily. In some situations it might be easier to handle longer rows and less of them; for example, 48-hill plots replicated to six or seven. In all probability similar differences could be measured as reliably as with 24-hill plots replicated to ten.

Number of Replicates

It is known that with single-row plots, forty feet in length, (a 24-hill plot, 18 in. between hills), the standard error of a single plot in per cent of the general mean of the experiment will vary approximately 15 per cent. The theoretical number of such plots, or replications, if you will, necessary to measure a particular difference with such a degree of precision as odds of 19:1 would be as follows:

Per cent difference to be measured

	5	10	15	20	25	30	35	40	45	50
No. of plots..	95	24	11	6	4	3	2	2	2	1

If longer rows are used the number of plots necessary to measure a given difference will be decreased approximately by the square root of the factor of increase. For example, a 10 per cent difference requires 24 plots of the 40 foot length. If plots 80 feet long are used, then approximately 17 plots would measure the 10 per cent difference with the same degree of precision.

If shorter rows are used then the number of plots would be increased by the square root of the factor. For instance, if plots 20 feet long were used then approximately 34 plots would be necessary to measure the 10 per cent difference with the same degree of precision.

Usually the shorter rows replicated more times are more efficient in use of land than the longer rows. However, the longer rows are more efficient in use of labor. It would appear to be a question for each investigator to decide himself.

Roguing

The committee recommends that no roguing be done in the yield tests. It is suggested that a separate plot be planted each year solely for seed production. Such a seed plot should be rogued severely. In the less extensive plantings tuber-indexing of seed stocks will keep disease at a minimum.

If there are important potato areas in the state which differ materially as to climate and soil from the conditions at the experiment station, then additional tests in those areas will be necessary. Preferably the entire trial should be repeated in each area for, conceivably, a seedling doing poorly at the experiment station might do well at some other location.

County Agent, Seed House, and Similar Trials

Presumably there would be but two or three new sorts to be tested at any one time.

It is suggested that long, single rows be planted, with every third row planted to the best locally adapted stock as a check. Replicate to five.

It might be well to plant shorter rows in order that the plots shall be the same number of rows wide as is covered by the local sprayer to avoid any inequality due to wheel injury.

Multi-row plots minimize varietal mixture in tests of this nature. Center rows might be saved for seed.

Plots planted by machine should be squared before harvesting.

If the harvesting operation is proceeding smoothly, then after digging one or two hundred-foot lengths could be marked off

immediately before picking and these data used as a measure of the relative performance of the different sorts, or the whole plot may be picked up.

Tests of this nature should be kept as simple as possible. Systematic planting is suggested. Student's method of analysis using the paired observations of each new sort and its adjacent check should furnish a reliable estimate of error. If one preferred, the analysis of variance method could be used.

Plot Layout

Systematic.—In order to use single-row plots it will be necessary to plant similar things together and to arrange the planting systematically. Having planted the seedlings at double spacing the natural growth of the seedling plant is easily determined, whether it be tall or short, erect or decumbent, early or late, and so on. With this information it is simple to arrange a systematic planting which will minimize competition.

Randomization.—Where competition is a serious factor single-row plots cannot be randomized. In order to randomize the plots it will be necessary to use multi-row plots at some stations.

Of the multi-row plots probably the five-row is most efficient because with only two-thirds more land the data area is increased three times. The three-row plot is quite wasteful of land.

Inasmuch as randomization is usually hedged about by one or more restrictions and any systematic arrangement is one of the many possible randomized arrangements the two systems are not so far apart as at first might seem to be the case. Granted that high-yielding rows tend to depress adjacent low-yielding rows randomization does not correct the situation. Randomization may decrease the total discrepancy for any one combination, but at the same time it makes it difficult, if not impossible, to detect the high-low complex or other effects of competition. On the other hand, if the plots are planted systematically, competition is so exaggerated that one cannot miss it. It then becomes possible to group the apparently higher-yielding ones, or the ranker-growing, or the taller ones by themselves for further testing. If a strain is high yielding simply because it grew next to a low-yielding row that fact will be discovered when it competes side by side with a real high yielder. It should be remembered that the purpose of a yield trial is to determine which strains are the high yielders.

The matter of systematic or randomized planting cannot be defi-

nitely decided in a report of this nature. Such a fact must be established from the results of many experiments designed to answer that question using different crops for several seasons in various localities. Until such information is available, your committee feels that the individual investigator should decide for himself which method to use. There are certain levels of mathematical significance which must be attained in order that experimental results may be considered reliable. What matters it as to the method used to reduce the data? Presumably randomization in many situations will deliver a smaller error or cause a lesser difference to be considered significant mathematically. What assurance is there that that small difference will persist out on the farm away from the particular location of the single experiment? Even ten per cent differences may disappear when strains are planted away from experimentally controlled conditions.

The analysis of variance method may be used to reduce the data from systematically planted experiments sacrificing none of its benefits except possibly that a larger error may result than would be true of a randomized planting. The most vigorous advocate of the analysis of variance, Dr. R. A. Fisher, himself has said, "It would not be unsound to apply the method to systematic plantings." Interpreting that statement in the affirmative one may apply the analysis of variance to data from systematic plantings.

Final tests which are used to measure small differences among a few varieties or strains that are quite similar in growth habit might well employ randomization, even use the Latin Square arrangement, but for large-scale experimentation most any plot arrangement with proper statistical analysis will uncover most of the desirable practices.

The use of checks is another controversial matter. Again an adequate discussion is not practicable in this report. It is admitted at once that the use of checks requires additional land and labor, but the knowledge gained from the checks more than repays the cost. A check row is very effective in visualizing the effect of location whereas statistical analysis, while it measures the effect mathematically, tells the investigator nothing as to why nor how the plots were affected. After all, experiments are conducted to find out why differences occur fully as much as they are to determine that differences do exist.

Assembling the Data

It is well to keep the data in their original form which presumably will be the pounds from each row. At the completion of

the analysis, conversion to an acre, basis may be made if so desired.

It is best to make note of any missing hills before harvest, but do not "correct" the observed data. Correction often results in greater error than no correction.

In certain experiments missing hills are part of the data. Certain strains may be inherently weak, they may have more seed piece rot because of defective suberization, or they may be relatively much slower in emergence or they may be more prone to rhizoctonia injury.

Every precaution should be taken to ensure a perfect stand.

Statistical Analysis

The analysis of variance method is probably most applicable to the more complex experiments involving many variables or large numbers of one or two variables. There should be no need to describe that method here.

The Latin Square, a special case of the variance method, is very useful for those experiments in which only one variable is concerned such as variety, or treatment, or seedling.

Student's method of measuring differences among paired observations is desirable when alternate rows or every third row is planted to checks as in the disease experimental plot arrangement. The table of "t" is best when determining probabilities by this method.

Other methods are available, but the data from properly designed experiments may be reduced to a reasonable estimate of error by one or more of the methods just described.

Interpretation

The committee deemed it advisable to include a few comments on the interpretation of experimental data that have been analyzed statistically. Most methods of analysis deliver a standard deviation of the experiment which, for convenience, is referred to as the standard error of the experiment or the standard error of a single plot.

Some investigators prefer to use the probable error rather than the standard error. The probable error is obtainable by multiplying the standard error by 0.6745, a constant. That is the sole difference between the probable and the standard error of any quantity. The interpretation is the same except that the probable error added to and subtracted from the mean sets up limits which divide the curve

of error so that the probability is .50 to .50 against a deviation being due to chance, whereas the standard error divides the curve so that the probability is .68 to .32 against a deviation being due to chance.

Which error to use ought to be optional with the investigator. Inasmuch as all probability tables and most tables of odds are constructed around the standard deviation or error the committee recommends the use of the standard error.

The interpretation of the probability or odds merits some discussion. Unfortunately there are two types of tables and there are nearly as many of one type as there are of the other. In the so-called one-tailed tables the probability is to be interpreted as being against a deviation greater than zero being due to chance, whereas in the two-tailed tables the probability is against a deviation greater than some upper limit or less than zero being due to chance.

An example may clarify the situation. Suppose that seedling number 44639 yielded 21 bushels more than the Green Mountain used as check in an experiment involving 10 replicates. The difference of 21 bushels has a standard error of 7 bushels. The ratio of 21 to 7 is 3. In a table of probabilities for small number experiments, such as Student's table of "t", the probability value is .9962 and the odds are 262:1. The difference is significant mathematically. This is a one-tailed table. The odds are 262:1 against any deviation greater than zero being due to chance and the Green Mountain would yield more than seedling 44639 only once in 263 times.

Using the same data, but interpreting the odds on a two-tailed basis, the odds are 130:1 against any deviation less than zero or greater than 42 bushels being due to chance. In other words the farmer may expect somewhere between no increase and 42 bushels increase 130 times out of every 131 times that the 44639 and the Green Mountain are planted.

Zero to 42 is a wide range for the grower who wants to plant about the same acreage each year and handle approximately the same total crop. Instead of limits of 3 times the error "7" suppose only 2 times the error is used. Instead of zero the lower limit is 7 and the upper limit is 35 and the odds are 32:1 for deviation one way and 15:1 for deviation either way. In other words, if the farmer plants 44639 he may expect an increased yield of between 7 and 35 bushels 15 times out of every 16. Narrowing the limits again by one unit of the standard error the limits become 14 and 28, the odds are 5:1 for one-way and 2:1 for two-way. Now the grower would expect that

2 out of every 3 times he planted 44639 he would get an increased yield between 14 and 28 bushels.

It is now possible for the grower to estimate much more closely the acreage necessary to maintain his average annual production if he uses the seedling 44639. Knowing that 2 times out of 3 he will get an increased yield between 14 and 28 bushels should be much more useful information to the farmer than that only once in 263 times he would fail to get some increase.

Mayhap a word of caution might not come amiss in concluding this report. Even though the probability or odds is so great that a difference must be considered mathematically significant it is wholly possible that the difference may be due to some factor or condition other than the one being measured. A difference may also be mathematically significant, yet be so small or unimportant as to be of no practical significance whatsoever. It should be remembered that the various statistical tools provided an experimenter are useful only to prove that the difference is or is not significant mathematically. No statistical method as yet devised will tell the experimenter why the difference occurred. Any clerk can calculate the several statistics from the data but the investigator must interpret those statistics.

After all is said and done, these several methods of statistical analysis which the mathematicians have placed in the hands of the experimenter are but a means to an end. They substitute one figure for many that one may more clearly and judiciously analyze the data from an experiment. The results derived through the use of these methods are of value only so far as the original data are of value. A wrong observation is never made right by means of mathematics. Accuracy of observation and recording are of extreme importance in all experimental work. Do not depend on the law of averages to compensate for errors of observation.

To state it all in a few words, plan the experiment so that some form of statistical analysis is applicable and calculate the statistics but do not then sit back with a satisfied air of work well done simply because the error has been determined; temper the statistics with a thorough personal knowledge of the experimental material based on observation throughout the progress of the research.

J. R. Livermore, *Cornell University, Chairman,*

H. O. Werner, *University of Nebraska.*

THE COMPOSITION OF TUBERS OF SPRAYED AND UNSPRAYED POTATO PLANTS IN RELATION TO COOKING QUALITY

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During the course of investigations on the effect of bordeaux mixture on foliage and tuber development of potato plants it was observed that tubers of sprayed plants darkened much less on cooking than did those of unsprayed plants. In the season of 1935 experiments were conducted to determine more specifically the effect of bordeaux mixture on the composition of the tubers with the thought of throwing some light on this question of cooking quality.

EXPERIMENTAL PROCEDURE AND ANALYTICAL RESULTS

Samples of tubers were selected at random at intervals during the season from sprayed and unsprayed plants. The spray was applied at the rate of 100 gallons to the acre and at 400 pounds pressure. The schedule of applications was as follows: For the first application a 5-2 ½-50 was used; for the second a 10-5-50; for the third a 8-4-50; for the fourth a 6-3-50; for the fifth a 4-2-50; and for the sixth and seventh a 2-1-50 bordeaux mixture. Therefore the total amount of copper applied amounted to seventy-four pounds to the acre during the season. These studies were made with the variety known locally as Heavyweight, a potato of the Rural group, grown at Gainesville in western New York during the season of 1935.

For the analytical procedure the tubers were thoroughly cleaned and ground to a pulp with a food chopper and well mixed before sampling. Representative samples were analyzed for total nitrogen, reducing sugars, sucrose, starch, copper, iron, ash, crude fiber and tyrosine.

Sucrose and reducing sugars were extracted after the method of Appleman and Miller (1926). After the removal of the alcohol and inversion of sucrose, the final determinations were carried out by the Munson-Walker method. Total nitrogen was determined by the official Guning method. The official A.O.A.C. methods (1930) were used for starch and crude fiber. Ash was determined by igniting dried material from the moisture determinations. Tyrosine was extracted according to Scovell and Menke (1887) and read colorimetrically after the method of Wu and Ling (1927). Copper was determined electrolytically from an ashed sample dissolved in con-

centrated nitric acid solution. The procedure for iron was that described by Farrar (1935). The Tinkler test (1931) to determine whether potatoes would blacken on cooking was applied to raw slices of potatoes from both the sprayed and unsprayed plants.

Experimental Results and Discussion

The analytical data given in tables 1 and 2 are tabulated on green and dry weight basis, respectively. On corresponding dates of sampling, tubers from sprayed plants showed higher percentages of sugars, starch, and copper than those of unsprayed plants (table 1). The total nitrogen was higher in tubers from unsprayed plants on all dates of sampling. These findings as regards nitrogen are in disagreement with the results of previous analyses showing always a higher percentage of total nitrogen for tubers from sprayed plants (Mader, 1936). The cause of this discrepancy is not understood.

Table 1.—*Percentage composition of potatoes from sprayed and unsprayed plants dug at different stages of development and analyzed immediately. All figures on green weight basis*

(Averages of 4 Analyses)

Date of Sample	Sugars		Starch	Total Nitrogen	Copper*	Ratio Protein-Starch (N.x6.25)
	Red. as Detrose	Sucrose				
Sprayed						
Aug. 6	.744	.171	9.840	.271	1.122	1 :5.8
Aug. 19 ...	.263	.651	12.170	.295	.983	1 :6.0
Sept. 3 ...	.053	.773	13.190	.290	.847	1 :7.3
Sept. 14.....	.039	.331	14.050	.323	.758	1 :7.0
Sept. 25.....	.065	.233	14.500	.327	.745	1 :7.1
Oct. 18 ...	.310	.151	14.250	.367	.657	1 :6.2
Unsprayed						
Aug. 6 ...	.697	.144	9.417	.294	trace	1 :5.1
Aug. 19 ...	.208	.543	8.130	.317	.222	1 :4.1
Sept. 3	.032	.531	12.660	.323	.291	1 :6.3
Sept. 14.....	.019	.141	12.970	.335	.411	1 :6.2
Sept. 25.....	.032	.117	11.780	.381	.444	1 :4.9
Oct. 18 ...	.167	.164	12.780	.460	.456	1 :4.4

*Copper in milligrams per 100 grams green tuber weight.

A considerable amount of copper was found in tubers from sprayed plants on the first date of sampling, August 6, and the amount decreased with successive samplings. Tubers from unsprayed plants showed practically no copper on August 6, but thereafter copper occurred in increasing amounts. These trends of copper content in tubers of sprayed and unsprayed plants were also found in previous experiments (Mader, 1933 and 1936). Tubers of sprayed plants showed a lower ratio of protein to starch than those from the unsprayed plants.

The data for the sampling of October 18, the date of final digging, are expressed on a dry weight basis, including copper (table 2). Especially noteworthy is the considerably larger amount of iron in the tubers of unsprayed plants compared with those of the sprayed plants. Although there were no great differences in dry weight, crude fiber, and ash content of tubers from treated and untreated plants, a rather striking difference was found between the tyrosine contents of the two lots. Tubers of sprayed plants showed about thirty-seven per cent less tyrosine than those of the unsprayed. When the samples were subjected to Tinkler's nitrous acid test, practically no discoloration of tubers of sprayed plants occurred, whereas those of unsprayed plants were severely discolored. Subjecting these tubers to cooking under laboratory conditions produced severe blackening in unsprayed tubers, against only slight discoloration in sprayed ones.

TABLE 2.—*Percentage composition of potatoes from sprayed and unsprayed plants dug October* 18, 1935 *and analyzed immediately*

Treatment	Dry Weight	Copper	Iron	Ash	Crude Fiber	Tyrosine
Sprayed	22.40	.0029	.0483	.8703	2.20	.422
Unsprayed	20.02	.0023	.0715	.9007	2.55	.667

ALL FIGURES ON DRY WEIGHT BASIS
(AVERAGES OF 4 ANALYSES)

To date the more striking results in the experiments are the lower tyrosine and iron content of tubers from sprayed plants. Since it has been shown by Tinkler (1931) that large amounts of phenolic compounds (in these experiments tyrosine) and iron are partially responsible for blackening of cooked tubers, it may be concluded that

spraying plants with bordeaux mixture has some value in counteracting this condition. The apparent effect of bordeaux mixture on the protein-starch ratio of tubers should receive further attention.

LITERATURE CITED

Appleman, C. O. and E. V. Miller. 1926. A chemical and physiological study of maturity in potatoes. Jour. Agr. Res. 33: 569-577.

Assoc. Official Agr. Chemist. 1930. Official and tentative methods of analyses. pp. 593. 3rd ed. Washington, D. C.

Farrar, G. E. 1935. Iron in biological materials. Jour. Biol. Chem. 110: 685.

Mader, E. O. 1933. Evidence of stimulation of potatoes by bordeaux mixture. Abstract Phytopath. 23: (1): 22.

Mader, E. O. 1936. The effect of different amounts of bordeaux mixture and of its seasonal distribution on foliage and tuber development of potato plants. Thesis. Cornell University.

Scovell and Menke. 1887. Leucine and tyrosine content of potatoes. Amer. Chem. Jour. 9: 103.

Tinkler, C. R. 1931. The blackening of potatoes after cooking. Biochem Jour. 25: 733.

Wu, Hsien and Schmorl M. Ling. 1927. Colorimetric determination of proteins in plasma, cerebrospinal fluid and urine. Chinese Jour. Physiol. 1(2): 161-168.

REPORT OF THE CERTIFICATION COMMITTEE OF THE POTATO ASSOCIATION OF AMERICA

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In past years it has been customary to prepare a statement of the production of certified seed potatoes in the United States and Canada. Since such data for the United States are now collected each year by the Hay, Feed and Seed Division of the U. S. Bureau of Agricultural Economics and a report has been issued by them, it would seem unnecessary for this committee to include this material in their report. A list of states certifying seed with the name of the person in charge in each state is submitted, however. Several additions have been made to this list since last year. The committee would appreciate having attention called to any other omissions or inaccuracies. Twenty-nine states are now listed. Word has been received that certification work is being started in one of the states of Mexico.

In past years the committee has at times recommended certain provisions for potato standards and these have sometimes been adopted by the Association in the form of an official standard. Although these standards have doubtless had some influence on the standards of the various states, the hoped-for approach to uniformity has often

been somewhat disappointing. Perhaps one reason for this lies in the nature of the bodies concerned in the drawing up of the proposed standards. The members of the Potato Association in general are not closely in touch with the problems involved in certification. Of those present at an annual meeting usually very few have any direct relation to seed certification work. Even the committee itself contains a rather small proportion of the certification officials and few of them take any active part in the drawing up of the committee report. When the proposed standard finally appears the individual certification official may be excused if he disregards it as having been drawn up by a group of amateurs and without due consideration for the problems in his state. If any effective organization of certification officials existed a committee of this organization might work with more effect. In the absence of such an organization perhaps more could be accomplished by the members of the committee dealing directly with the officials representing states in their particular territory, calling their attention to features of the particular standard which were markedly out of agreement with the majority or with the proposals of the certification committee. In this way the official approached would be put in the position of either modifying the standard of his state or defending his position in refusing to do so. In this way the committee might become apprised of problems it has overlooked and might be led to modify its recommendations. It is recognized that the mere fact of being in a minority does not necessarily imply that the individual state is wrong. If progress is to be made there must be new ideas which will at first be adopted by only one or a few. The recommendations and suggestions of the committee given below are then to be regarded as only tentative, a working basis for the present. These suggestions represent slight modification of those made last year and are as follows:

1. *General.* In form the standard should be clear, logical, concise and definite. It should contain requirements which must be met to bring about the certification of seed stock. Requirements regarding applications and fees should be given separately. Recommended practices which are not required should be also separated. The means by which the desired ends may be attained should not be included unless the grower is required to use these means. In general the standard should deal with the results rather than with the methods. In specific cases, however, certification authorities may feel that certain methods are so much more efficient in attaining a desired end that they should be required or that it is easier to determine whether

a grower has applied certain methods than whether he has reached the desired goal. In these cases it may be justifiable to specify the method. Matters concerning the technique of inspection, when, how often, or in what manner inspections are to be made are not properly part of the standard. Nothing in this paragraph is to be construed to prevent giving to the grower the information mentioned. Those responsible are urged to provide the printed or mimeographed standards with a date.

2. *Grade.* U. S. No. 1 is undoubtedly the most widely known grade in this country. This grade should probably form the basis for a certified seed grade. To make this grade satisfactory it may be necessary to define some defects more definitely and to improve the grade by certain additional restrictions as mentioned below. If U. S. No. 1 forms the basis of a seed grade the standard should so state.

3. *Size.* In U. S. No. 1 the permitted size is "not less than 1⅞ inches *unless otherwise specified*". Thus any size agreeable to both buyer and seller may be used. The U. S. grades also define Size B as "1½ inches to not more than 2 inches in diameter". This meets the need for a small seed grade. The use of the term No. 2 to indicate this size is undesirable and ambiguous because the U. S. grades define No. 2 as potatoes from 1½ inches up, with somewhat more tolerance for defects than permitted in U. S. No. 1. It seems generally recognized that very large potatoes are undesirable as seed. Many of the states have placed a maximum size limit of 10, 12 or 14 ounces. It is suggested that a maximum of 12 ounces be permitted unless there is a written agreement between the contracting parties for a larger size.

4. *Rhizoctonia.* The following definition of damage due to Rhizoctonia should be added to the U. S. No. 1 grade. "Rhizoctonia in potatoes for seed purposes when the general appearance of the potatoes in the container is materially injured or when individual potatoes have more than 5 per cent of the surface covered in the aggregate". Some members of the committee feel that this is not severe enough. This question hinges to some extent on whether one grade only is permitted or whether lower grades are available. This question is discussed in section 7.

5. *Scab.* The following definition of damage by surface scab should be used in the U. S. No. 1 grade. "Surface scab in seed potatoes which covers an area of more than 3 per cent of the surface of the potato in the aggregate". The present definition allows 5 per cent. (Same comments as under Rhizoctonia above.)

6. *Color of tag.* Wherever not inconsistent with considerations of convenience or tradition the color of the tag of the best commercial grade of certified seed should be blue. If a second grade is used the color should be red. This may be unimportant if only one grade is to be used but if more than one grade is to be used it is desirable for various states to be consistent.

7. *Number of grades.* Usage in most states provides for only one grade of certified seed. There are at least nine states, however, which provide more than one grade for certified seed with different tags and one state provides for four. The committee is still not ready to make a decision between these two systems. An argument in favor of more than one grade is that it permits the recognition of virus-free seed which is not of high grade thus opening a lower priced market for what may be classed as a by-product and allows the first grade to be made more strict to satisfy the more particular buyers. An argument in favor of a single grade is that the buyer is not educated to discriminate between the two grades and the presence of the poorer grades on the market injures the reputation of the state issuing the tags. There is also the competition offered by the poorer grade at a lower price.

8. *Regional meetings.* To bring about greater uniformity in the interpretation of standards, it is suggested that regional meetings be held where inspectors from several neighboring states may come together under field conditions. Such meetings for the northeastern states have been held in New Jersey and have proved very useful. For virus diseases it is convenient to hold such meetings in an early potato section before inspection work starts in the certifying states. For tuber inspection it may be desirable to hold additional meetings after harvest time.

9. *The testing of certified seed.* It is obvious that uniformity in the standards of different states will never result in uniformity of the product. All methods of potato inspection so far available only show us the amount of disease present in the parent stock while the amount of disease in the product is only determined during the ensuing season. Reports from consuming districts indicate that the product of different areas may differ markedly even though the same standards are used. Some of the certifying states are attempting to study these differences by growing samples of the product. Some of the consuming areas have also attempted to carry on such tests. In the first case no information is obtained as to the comparative freedom from disease of potatoes from different states and in the second case

the results of the test are often of more than doubtful value because of inadequate sampling and the inexperience of the inspector. There would seem to be a need for the carrying on of such tests by an impartial and competent agency to at least supplement the efforts of the individual states. Such an agency could help in two ways.

First, by providing a testing ground in the south under competent supervision where the certifying states could send samples for their own information.

Second, by the collection and testing of representative samples of the commercial seed stocks from different states under the same conditions.

This committee has now functioned with approximately the same membership for two years. Although the members of the committee will be glad to serve the Association further in any way they can, the questoin is raised as to whether the aims of the Association would not be better served by the appointment of a new committee. It is obvious that the work of the committee has not been completed and it is doubtful whether it will ever be completed.

Respectfully submitted,

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SECTIONAL NOTES

Alabama

It is estimated that from approximately 30,000 to 32,000 acres will be planted to Irish potatoes in this early potato section. This is an increase of nearly a third more than the 1936 acreage. This estimate is based on the amount of seed potatoes already received and which are planted or will be planted within the next two weeks. In South Baldwin Co., alone, a production of 5,000 cars is possible this season. Our crop usually begins to roll to northern markets about May 1st.

The two leading varieties of Irish potatoes are the Triumph and the Cobbler. Most of the seed potatoes used for planting the crops came from Wisconsin and Minnesota.

To date, February 10, favorable growing conditions prevail. The field appearance is favorable from the standpoint of vigor, freedom from disease, and satisfactory vine growth.

The increased cost of seed and fertilizer is expected to reduce the net profits to a certain extent as compared with 1936. The fact that the nation has its lowest potato supply, and also that the apparent growing tendency is for growers to increase their acreage because of the higher prices of 1936, may result in disastrous prices in 1937. (Feb. 14).—Louis Soffcke.

Louisiana

The Louisiana growers are now in the midst of planting. From all indications, there will be from a 10 to 15 per cent increase above the previous season. There would have been a much larger increase had it not been for the extremely high cost of seed. The Louisiana growers are paying more for seed this year than during any season in recent years.

Although we have tested the Katahdin at the Experiment Station for the past seven years, we have not been able to get sufficient seed to conduct a commercial test until this year. We have made arrangements for five cars of seed to be planted this season. During the past seven years, the Katahdin has out-yielded the Triumph and has also surpassed the Cobbler as a white potato for Louisiana. In the past, Louisiana has been strongly a Triumph variety district. So far we have not recommended planting white potatoes because of the fact that we have not had a variety ideally suited for Louisiana. Our experimental evidence demonstrates that the Katahdin is apparently the best of the white-skin potatoes that we have at present. The other seedlings, such as the Houma, will be planted later, as soon as sufficient seed is available for commercial plantings. (Feb. 5).—Julian C. Miller.

Maine

Maine farmers have shown a great deal of interest in the 1937 Agricultural Conservation program as evidenced by the attendance at meetings which have been held throughout Aroostook County during the last three weeks. Probably the attendance has been almost at a record for community meetings of this type. A further indication of the interest on the part of growers in this section is that practically as many work sheets have been filled out to date as were filled out for the entire season last year. There has been a splendid interest in adopting the approved soil practices for the improvement of farms. This has been most encouraging in the development of a sound, long-time Agricultural policy for Maine.

A great deal of discussion is developing on the operations of the Branding Law adopted two years ago by the State Legislation. A movement is on hand to repeal it at the present session but it lacks the support of many growers. The majority of growers and practically all business interests are uniting in supporting the present law, feeling that although some changes are desirable, nevertheless repeal is not warranted and that repeal would set the industry back many years. More and more growers are coming to the support of the present Law as they have opportunity to inform themselves of all the issues involved.

Identified with the Branding Law in the public mind is the Tax Bill recently introduced in the State Legislature levying a sales tax of one cent on each barrel shipped out of the state's production. The Law further provides that monies received from the operations of this Law would be expended under the direction of the Maine Development Commission to be used in advertising potatoes and in doing research work in marketing and related activities. There is a rising tide of sentiment in favor of this measure also.

Growers are becoming more conscious of the responsibility that they have in developing their marketing program. Production is only one-half of the battle. Marketing is of equal importance. Money expended in developing demand for Maine potatoes in the markets is sound investment It is vitally necessary that the industry as a whole, that is, in other states as well as in Maine, recognize the paramount necessity of combating the decline in consumption of potatoes. We hope our efforts here are successful for it may stimulate activity in other areas also.

Potato growers are becoming more conscious of their industry as a National one, breaking down state and sectional lines, appreciating that potato growers everywhere are inevitably linked together. The Warren Potato Bill probably did more to develop this consciousness than any other one proposal or program. This accomplishment, in itself, made the effort worth while.

Weather conditions have been very favorable all winter. Conditions for shipping potatoes have been almost ideal. What the balance of the winter and spring hold for us is, of course, unknown, but to date Maine has been enjoying a very unusual season.

The demand for seed potatoes has been record breaking, both in selected and certified grades. Growers have been, on the whole, free sellers of seed and if the demand continues as it has been to the present time, it is doubtful if the supplies, yet unsold, are sufficient.

It is expected now, on the basis of shipments made to date in addition to the amount of potatoes now in storage, that Maine will ship forty-five to fifty thousand cars this season. The poorer part of the crop has been shipped and it is reasonable to expect considerably better quality on the balance yet to move. Because of the warm weather, however, potatoes have germinated earlier than usual and this may be a serious factor affecting the quality as the season progresses.

Maine is watching developments in the National Agricultural program with interest. Growers are ready to assume their responsibility in the development of a sound national agricultural policy for all producers regardless of location or commodity. (Feb. 12). —Frank W. Hussey.

Thirteen hundred cars of Maine certified Cobblers; 285 cars of Spaulding Rose; 200 cars of Mountains and 200 cars of odd varieties have already been shipped to market this season. At this date last year we had only moved 1,300 cars. There seems to have been an increased demand for Spaulding Rose in the Florida district and for Cobblers in North and South Carolina. The southern sales are amounting to approximately the same as in 1934 and in 1935. This week the bulk of the stock is going to North and South Carolina and a few cars to Texas, Ohio, Virginia and Pennsylvania. A mixed car of Goldens and Katahdins was shipped to Minnesota.

Even though sales have been encouraging to this point we are not sure what effect Canadian importations, under the reciprocal trade agreement, will have on the Maine total for the season. Stock which has been held in bond will be released to the trade within a month or six weeks.

A recent letter from Louisville indicates that a car of certified seed from Maine was under water for ten days. A request for new tags had to be refused on account of the state law but we were able to furnish a certificate stating that such a shipment had been made from certified seed grown in Maine.

The table stock market is dull. The price of seed, for some unknown reason, is always based on the table stock market. Although the price is fair, Maine certified growers are not getting the price to which they thought they were entitled after several poor seasons.

Quotations today on certified Cobblers are $3.40, 10 peck sacked, tagged and loaded. (Feb. 10).—E. L. Newdick.

Mississippi

Mississippi will plant 3,000 acres of commercial spring Irish potatoes as compared with 2,000 acres last year. The crop is now being planted in the extreme Southern part of the state and planting operations will continue for the next few weeks. The growers are enthusiastic and if they are able to get more seed of the last minute they will increase their acreage still further.

The favorable outlook for prices during May and early June has been quite widely disseminated in the state and the growers are aiming to plant as many acres as possible. The high price and scarcity of Triumph seed potatoes will keep the increase from becoming much greater. On the whole, the Bliss Triumph variety is planted by most growers. (Feb. 10).—T. M. Patterson.

North Carolina

The planting of early potatoes has not yet begun, but will be in full swing this coming week if the weather is favorable.

No definite estimate of the acreage to be planted is available, but the high price of potatoes is almost certain to result in a larger acreage than last year. Seed is higher but with more money available, it is doubtful if this will deter the grower from planting. (Feb. 13).—Robert Schmidt.

Pennsylvania

The potato marketing plan as set up to assist in the merchandising of Keystone State potatoes was somewhat unique in its inception, unusual in its functioning, and is proving to be far reaching in its effect. The need for the improved marketing of Pennsylvania potatoes had for years been an unanswered problem confronting the industry. With many of the country's principal consuming centers located within the state, the cream of these markets was being skimmed off by producers in other states, leaving skimmed milk, so to speak, for Pennsylvania producers. A joint committee composed of the officers of the Pennsylvania Potato Growers' Association and representatives of the Pennsylvania retail distributing groups conceived a plan whereby the best Pennsylvania potatoes, properly graded, attractively packaged and systematically distributed could receive preferential treatment in Pennsylvania markets. A corps of men trained as inspectors, lo-

cated in every producing county of the state were subsequently licensed by the Association to pass on all shipments made from county points. The State Dept. of Agriculture assisted in the training of these men and has checked their work continuously. The plan has allowed much flexibility in the way that variable local conditions are made to fit into the state-wide organization. Growers may pack individually, in cooperative groups, or may sell through local dealers, who are properly equipped. Each county is limited to one contact man who daily reports offerings to the central office, where the sales manager contacts and quotes the state-wide offerings to state-wide buyers. The sale is made by the main office but the returns are passed back directly to the county contact men.

Shipments during the first six months were made from all the important producing counties of the state. Quality has been maintained quite uniformly, considering the magnitude of the task undertaken, and a responsive consumer demand has developed to so great a degree that the supply reaching city markets has been insufficient to meet the needs of the cooperating 17,000 stores. Another most gratifying effect has been the marked improvement in the price level for all Pennsylvania potatoes, whether shipped by the Association through its central office in Bellefonte, or whether sold in the open market. It has been estimated that this price enhancement as applied to the 1936 crop has benefited Pennsylvania growers by at least $3,000,000. (Feb. 8).—D. M. James.

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CERTIFIED SEED FOR LARGE YIELDS

The fact that the potato grower purchases certified seed is not an absolute guarantee of a crop. Very often the seed is so handled after it has been delivered that its original vigor is seriously impaired. Again, some growers have the mistaken idea that if certified seed is purchased there is no need of disinfecting it. It is impossible to adopt standards for seed potato certification which eliminate diseases such as scab and rhizoctonia. If this were done the amount of seed that could be certified would be so small that its cost would be prohibitive. The certification of seed potatoes is concerned largely with the elimination of seed-borne diseases which cannot be detected in the seed or which will not respond to any form of seed treatment.

All states make an effort to reduce to a minimum the amount of rhizoctonia and scab permitted on certified seed potatoes. Since some infection must be permitted, however, the purchaser of certified seed potatoes must give more thought to the value of seed disinfection. Several methods are now available whereby this may be satisfactorily accomplished. In addition to seed disinfection it has been definitely demonstrated that the rhizoctonia disease is most severe where deep planting is practiced. If deep planting is necessary because of local conditions the grower should at least, provide for shallow covering at planting time. This will greatly reduce the extent of rhizoctonia infection which follows where the seed piece is planted deeply.

If satisfactory yields are to follow, good seed must be planted. Purchase certified seed. Cut a seed piece of sufficient size—an ounce piece is usually satisfactory. See that the seed is free from rhizoctonia infection,—this may require disinfecting. Handle the seed properly after it is cut and see that it is not planted too deeply. Care in these various operations will go far toward ensuring a crop. Failure to give proper consideration to any of these factors may be followed by poor stands and low yields.